Appendix 4
Clark Fork River Flows Over Various Averaging Periods

As noted in Chapter 6, in trying to understand the significance of the existing hydropower water rights in the lower Clark Fork basin and their implications for future basin water rights and for water users with rights junior to the hydropower rights, the Task Force examined flow analyses conducted by two of its members. These analyses did not reach the same conclusions. The Task Force did not endorse either. The following is a summary of the two analyses.

Analysis Presented by Representative Verdell Jackson

Rep. Jackson considered information about water use and flows and state statutes to determine if Avista's hydropower water rights present a problem for existing and future water use in the basin. He concluded that one cannot demonstrate now that the Avista rights present a problem for the Clark Fork River Basin and especially the Flathead subbasin. The factors he considered and his analysis of them include the following.

<u>Existing Basin Water Resources</u>
The subbasin has abundant surface and groundwater resources. The Flathead drainage has 3,500 miles of streams and 450 lakes including Flathead Lake. The usable water in Flathead Lake is 1,700,200 acre-ft. The total volume is estimated to be 20 to 25 million acre-ft. Hungry Horse Reservoir has 3,467,179 acre-ft usable water storage. The abundance of this water provides recharge to the ground water and most likely is the reason that the Bureau of Mines at Butte has found no decrease in the water table as a result of groundwater development to date. The capacity of groundwater for development is not known, but is considered to be extremely large compared to the small amount of water being used for development each year.

<u>Bad Data and Data Gaps</u>
The existing data base on water appropriations and use can not be used to demonstrate that all of the water has been allocated in the Flathead subbasin because of missing and duplicate data. In the initial draft of chapter 3 on the watershed profiles, a consultant wrote, "Information describing existing appropriations of water represents the most significant gap in information and knowledge required for basin planning and management. As a whole it cannot be considered to be accurate, consistent, and reliable." The problems with this data include:

$ The failure of existing water appropriations to specify consistently the period of use.

- $ The rate and volume are not separated by use for each water right identification number. For a given identification number, either a rate or a volume were commonly found, but not both.
- $ Multiple entries for an identification number were found approximately 43% of the time.
- $ Priority dates were missing in some cases.

Also, in the water rights data, consumptive uses are not separated from non-consumptive uses. Non-consumptive uses dwarf consumptive uses. Less than 1 million acre-feet in 76LJ (Flathead River) are allocated to consumptive uses while more than 7 million acre-feet are allocated to non-consumptive uses, primarily fisheries. Nearly all of the consumptive use on the South Fork lies in an irrigation right held by the Bureau of Reclamation which has not been utilized. Also, correlation between allocation and actual use or depletion is unknown. With consumptive uses, return flows are not considered. For example, based on records of water use by the City of Kalispell, the return flow from domestic use is between 70 and 73%. With irrigation the return flow is generally believed to be 44% to 50% but could be much higher. In the case of non-consumptive uses, the return flow is generally 100%. These data problems and data gaps prevent one from demonstrating that existing water uses have consumed the available surface or ground water in the Flathead subbasin. Measuring the actual flow of water in the rivers over a long period of time is likely the most accurate measure of water depletion resulting from water uses. The USGS (United States Geological Survey) has been doing this for 92 years. Presently, the volume of water used by junior water right holders is unknown.

Implication of Basin Water Use for Avista's Water Rights

As of June 2, 1998, Montana's Centralized Water Right Records System identified 26,274 surface water uses for the Clark Fork Basin. Thirty percent of these were junior to the most senior water right at Noxon Rapids Dam (35,000cfs with a 1951 priority date). Only 3,125 uses are junior to the most junior Noxon Rapids water right (15,000 cfs with a 1976 priority date). The uses of the water rights junior to Avista's as of June 2, 1998 by number were: 40% irrigation, 32% municipal, 16% stock water, and 12% unknown.

The impact of total basin irrigation on water available to Avista at its Noxon Rapids project is estimated in the following table. Average yearly flow of Clark Fork River near Plains is 14,567,770 acre-feet (45 year average).

Table A4-1

Total Basin Acres Irrigated	Water Allotted	Average Used	Average Consumed	Depletion	Percent of Annual Flow
470,000 ac	X 2.5 ac/ft	X .67	X .56	= 440,860 ac/ft	3.03%
428,000 ac	X 2.5 ac/ft	X .67	X .56	= 401,464 ac/ft	2.76%
411,000 ac	X 2.5 ac/ft	X .67	X .56	= 385,518 ac/ft	2.65%

Thus using three different estimates of the basin's irrigated acreage, basin irrigation consumes between 2.65% and 3% of the average annual river flow at Plains. Irrigation has traditionally been the largest water user. As is seen in Table A4-2, the growth in irrigation from 1950 to 1980, using data from the 1983 Depletion Task Force Report, consumes only about 0.44% of the average annual flow of the Clark Fork River near Plains.

Table A4-2

	Total Acres Irrigated	Water Allotted	Average Used	Average Consumed	Depletion	Percent
Prior to 1950	358,000 ac	X2.5 ft/ac	X.67	X.56	= 335,000 ac/ft	2.3%
1950-1980	69,000 ac	X2.5 ft/ac	X.67	X.56	= 64.000 ac/ft	0.44%
Total	427,000ac	X2.5 ft/ac	X.67	X.56	= 400,526 ac/ft	2.75%

However, this figure is overstated because when the irrigated acreage was compiled, the irrigated acres were double counted in the reservoir records and change of use authorizations. According to the Cunningham Report, between the years of 1950 to 1980 the additional water use was 60,600 acre-ft, which is .4% of the average annual flow in acre-ft at Noxon Rapids. The Cunningham Report further concluded: "In the early 1950s Hungry Horse Dam was completed and has provided flow benefits to WWP (Avista) at both Noxon Rapids and Cabinet Gorge Dams. It can be argued that these modified flow releases from Hungry Horse dam have mitigated any power losses that would have occurred from increased irrigation depletions in the Flathead." Because additional development of irrigated acreage in the basin is very small, the development will not have an adverse impact on Avista's hydro power water supply. Also, agricultural land is being converted to residential and commercial at a very high rate.

<u>Historic River Annual Average Flow Data</u>

The USGS data on historic annual average river flow at Polson, St. Regis, and Plains are shown below in Tables A4-3, A4-4, and A4-5, respectively. These data show that the 45 year average river flow since Avista built its hydroelectric dam at Noxon is higher than the preceding 45 year average. This is true at all three water measuring sites: Polson, St. Regis and Plains. Also, the average for the last 10 years at each site is higher that the average for the last 45 years. There is no evidence from the water flow data for the Flathead River and the Clark Fork Clark River that the water supply for Avista has been adversely affected by increased water use. The depletion is actually very small compared to the total water available

Historic River Monthly Average Flow Data

Table A4-6 shows the monthly average flows in the Clark Fork at Plains, again based on USGS data. Mr. Jackson noted that the 45 year monthly average flows since construction of the Noxon Rapids Dam, i.e. 1956-2000, is higher for January through April and September through December than for the 45 years preceding the Dam, 1911-1955.

Thus using monthly flow data, Rep. Jackson concluded that no measurable negative impact on Avista's water rights occurs as a result of farm and ranch land irrigation during the summer months or at any other time. The use of storage behind Hungry Horse Dam and in Flathead Lake also has been of great benefit to Avista.

Historic River Daily Average Flow Data

Figures A4-1 and A4-2 show the USGS data on daily flows at Plains for two periods, 1910-1954 and 1955-2001. Plotted on the two charts is the average daily flow. Again from this data, Rep. Jackson concluded that the data do not demonstrate that the water development since construction of the Noxon Project has had a significant adverse impact on Avista water rights or water use when all of the data from the 92 years of USGS records are included.

Monthly averages mitigate high water flows during the month and therefore underestimate the rate of water flow into Avista on a daily basis. Since Avista has minimal storage capacity, it is considered to be a "run of the river" electricity generation facility. An analysis of the water flow from 1911 to 2000 reveals that water flows into Avista exceeds their capacity to generate (50,000 cubic feet per second (ft^3/sec) during April, May, June and July, thus resulting in spills. Spills happen about 9 out of every 11 years or 82% of the time.

Based on 45 years of daily water flow data on the Clark Fork River before the Hungry Horse dam was built, Avista would have spilled an average of 1,592,322 ac/ft per year. (Spills computed on a monthly average basis are 1,220,953 ac/ft per year). Almost all of the spillage occurs during May and June.

After Hungry Horse was built in 1955 and began operating, calculations show that only 878,786 ac/ft per year of water was potentially spilled because the combination of Hungry Horse and Flathead Lake storage reduced river flows during the normal high runoff months and redistributed them over the lower flow months. Specifically, depending on how it manages its own Noxon Rapids' storage, Avista should be able to utilize for power production an additional 713,536 ac/ft per year spread over the 8 months of lower flows.

During the last 10 years the operation of Hungry Horse has taken even more of the peak run off during May and June and added it to the flows in August, November and December. The average spillage for the last 10 years has now been decreased to 670,948 ac/ft per year which increases the average amount available per year to Avista up to 921,374 ac/ft. This amounts to about 6 ½ % of the average flow of the Clark Fork River at Plains (14,234,467 ac/ft). Thus, the management of the water flow by Hungry Horse Dam has enabled Avista to utilize 921,374 ac/ft which is more than twice the amount of water depletion used for all irrigation (400,526 ac/ft).

Based on data from the 1983 Depletion Task Force Report, 69,000 acres were converted to irrigation between 1950 and 1980. These irrigators would be junior water users to Avista's 1950 water right and subject to a call by them. The water depletion attributed to these junior users is estimated to be 64,000 ac/ft. See table A4-2. This amount of increased water use by irrigators since 1950 is a meager 7% of the extra water Avista is able to utilize as a result of the water management by Hungry Horse Dam.

<u>Analysis of the Likelihood of a Call on Junior Water Users or a Basin Closure to New Water Rights</u>

Avista should NOT make a call on junior water users or push for a basin closure to new water rights for the following reasons:

1. The operation of Hungry Horse dam has totally mitigated the impact of irrigation on water available to Avista for the present and the future. The total amount of irrigated land in the Clark Fork River Basin is estimated to be between 411,000 and 470,000 acres. The water consumed to irrigate this much land would be less than half of the extra water made available by Hungry Horse Dam.

2. Although Avista has a right according to Montana water law to make a water call on junior water users, they must also prove that the water will arrive at Avista in sufficient quantities at the right time to have a measurable impact on their production of electricity.

3. The timing of irrigation occurs when the most water is available. The winter run off starts late in April and peaks in May or June and ends early in July. Irrigation starts early in May, tapers off in August and ends in September. Irrigators take most of their water during high flows and about half of that water returns to the river during late summer and fall. It is very likely that irrigators consume a portion of water and also store a portion of water in the ground that would have spilled at Avista during May and June. Later in the summer and during the fall a portion of the ground water returns to the river and is utilized by Avista.

4. Most of the irrigation water rights are senior to Avista's 1950 senior water right of 35,000 cps. The only irrigation water rights in danger of a call by Avista would be those with a priority date after 1950. The number of water rights that are junior to Avista's 1976 water right of 15,000cps is 3,125 out of a total of 26,274 water rights. The amount of water consumed by these

junior water users would be very difficult to determine. The make up of the junior water rights is 40% irrigation, 32% municipal, 16% stock and 12% unknown. The number of irrigated acres added between 1950 and 1980 is estimated to be 69,000. The amount of water involved to irrigate that much land would be less than ½ % of the total water available from the Clark Fork River and would not be measurable at the Avista facility. In fact, 5% would be difficult to measure considering the unpredictable operation of Hungry Horse Dam, Kerr Dam and Avista's facilities.

5. There are many characteristics of Avista's water right that indicate that the water right was crafted to enable Avista to maximize their use of the maximum rate and volume that would be available in the Clark Fork River.

Avista's water rights
1951: Rate: 35,000 cfs, Volume 25,338,843 ac/ft per year
1959: Rate: 5,400 cfs, Volume 3,909,421 ac/ft per year
1974: Rate rose to 50,000 cfs

Over a period of years (1951 to 1974), Avista continued to request more water rate from DNRC until the total reached 50,000 cfs. This rate is 2 ½ time the average rate of flow of the Clark Fork river (20,000 cfs). Likewise the water right for volume is 29 million acre feet per year which has never been available. The average yearly flow of the Clark Fork River is 14 million ac/ft and the largest amount on record is about 20 million ac/ft. Avista likely analyzed peck flow data to compute cost of additional generation capacity against revenue from water they were spilling and sized their facility and water rights accordingly. The amount of water that they are now spilling, although significant, most likely is not worth the extra cost of more generation capacity.

Each request for additional rate and volume of water was approved without specifying the period of time when the rate was available. Since there is no detail in the water right certificate protecting water rights senior to Avista's water rights or future use of water for commercial or residential development in the Clark Fork Basin, the possibility of a water call on junior users by Avista probably was not on the radar screen. Judge Holter in 1986 clarified the magnitude of the water rights and stated that "WWP continued to beneficially use all of the water that it appropriated to the extent that such water has been available in the Clark Fork River." He did not mention the fact that the 50,000 cfs was only available a few days a year and sometimes not at all or that the stated volume has never been available. Also, no mention was made regarding the possibility of a water call on junior water users as a result of the overstatement of volume and rate. Had this possibility been considered, language would certainly have been added to make sure that the interest of citizens of Montana would have been protected. Since Avista was not required to prove that the water was legally and physically available to meet their huge water right requests and no restrictive language was placed on their water rights, does this mean that it is too late to correct this oversight? I think not, the final decree has not been done and the pre 1973 water rights have not been looked at. Historical use data must be considered as well as the operational efficiency of Avista. The impact of rain fall and snow pack in the Clark Fork River Basin dwarfs impacts by water users.

6. Examining the 92 years of flow data over any averaging period one chooses: annual, monthly or daily, average flows in the lower Clark Fork River have increased since Noxon Rapids Dam was built. One can, therefore, conclude that the flow data do not show any evidence that the water supply for Avista's dams is being negatively impacted and that no measurable negative impact on Avista's water rights occurs as a result of new water rights or farm and ranch land irrigation during the summer months or at any other time.

7. The calculations done on a daily basis are more accurate than the calculations that were done using monthly averages. Monthly averages mitigate high water flows during the month and therefore underestimate the rate of water flow into Avista on a daily basis. Since Avista has minimal storage capacity, it is considered to be a "run of the river" electricity generation facility. An analysis of the water flow from 1911 to 2000 reveals that water flows into Avista exceeds their capacity to generate (50,000 cps) during April, May, June and July, thus resulting in spills. Spills occur about 9 out of every 11 years or 82% of the time. This is assuming that Avista operates its dam to make maximum use of the water available.

8. Water for irrigation was part of the justification for building Hungry Horse Dam. The Bureau of Reclamation filed a water right of 500,000 ac/ft when the Hungry Horse dam was built to provide additional water for irrigation. It is unlikely that this water will be needed by irrigators because development is causing a net decrease in the amount of land being irrigated. However, this water should be available to the citizens of Montana for future development and not be diverted to other uses.

9. Spillage of 671,000 ac/ft at Avista indicates that more storage and/or irrigation are necessary to get maximum value from Avista's facilities. Avista should be encouraging reservoirs and other means of storage to be built and filled during peak flows. An additional reduction of spillage of 7% would most likely completely mitigate the entire amount used by junior water users.

10. Public relations are very important to out of state corporations doing business in Montana, especially when their product is sold out of state. The small amount of potential profit from a call or closing the Basin to new water rights would not be worth the ill will that would generated by such actions. . In Montana, people are generally good neighbors and share shortages rather than taking all they can get. In the case of Avista, the hydroelectric project got to the water supply early with the capacity to take it all. Avista may not consider sharing if their priority is solely on increasing profits without regard to other options. Montana's water may not have been adequately protected for use for the welfare and benefit of all of the people of the state as required by state law, but many options are available to prevent the end of economic development in western Montana that depends on water availability.

<u>Subordination of Cabinet Gorge's Water Rights</u>

When Washington Water Power began to construct the Cabinet Gorge hydropower facility across the Montana border in Idaho on the Clark Fork, the Montana legislature wanted to ensure that the state's ability to use water in Montana would not be limited by an out-of-state water use. The Montana Legislature passed the following statute in 1951: Montana Annotated Code 85-1-122. Clark Fork River. The waters of the Clark Fork River may be impounded or restrained within the state of Montana for a distance not exceeding 25 miles from the Idaho-Montana boundary line by a dam located on said river in the state of Idaho and constructed by any person, firm, partnership or corporation authorized to do business in the state of Montana. Any present or future appropriation of water in the watershed in the state of Montana for irrigation and domestic use above said dam shall have priority over water for power use at said dam.

This language subordinates any Montana water right held by WWP at Cabinet Gorge (36,000 cfs and 26,062,410 ac/ft per year with a priority date of 1951) to future irrigation and domestic water uses upstream of the dam. Cabinet Gorge Dam is located in Idaho but 98% of the reservoir behind the dam is located in Montana. This same provision was not enacted when Noxon Rapids was built which was about the same time. The State of Idaho has a preference clause in its water right statute that places hydropower at the bottom of the preference list.

Table 6

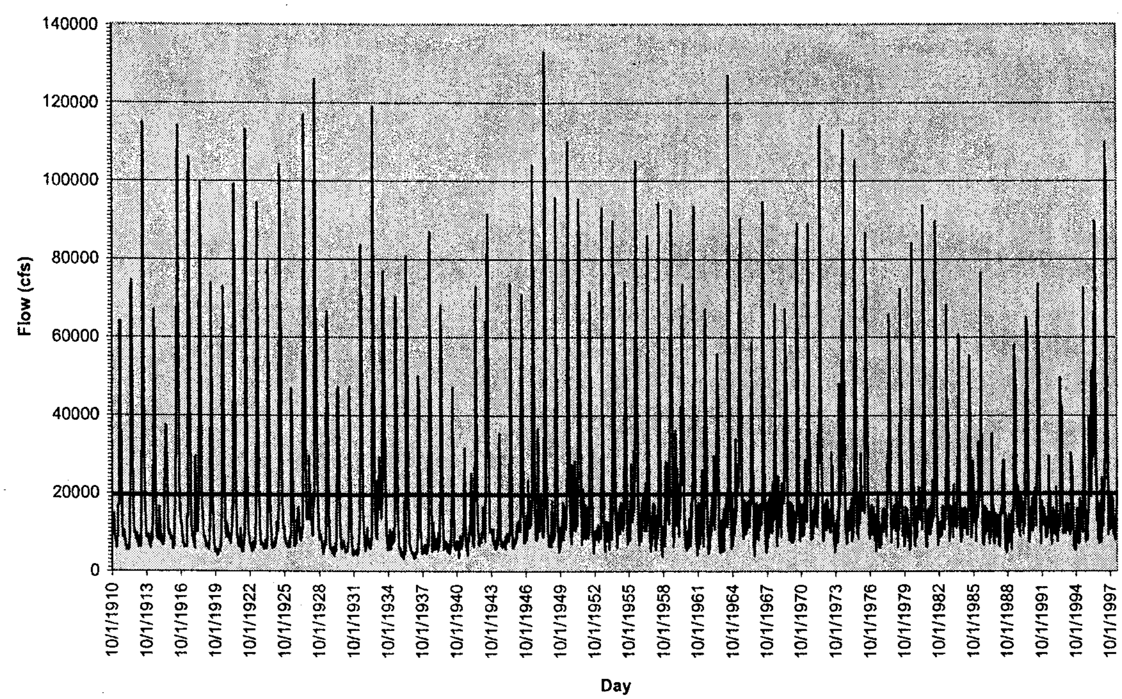
USGS CLARK FORK at Plains 1911-2000

Year	Avg Annual (AF)		
1911	13,935,095		
1912	13,766,340		
1913	17,40,5335		
1914	12,940,621		
1915	10,972,214		
1916	20,25,4893		
1917	1,7490,665		
1918	17,160,460		
1919	10,340,607		
1920	13,481,240	**14.774.767**	**10 Year Avg**
1921	15,922,216		
1922	13,946,502		
1923	14,158,061		
1924	11,526,364		
1925	17,698,038		
1926	10,024,788		
1927	20,293,339		
1928	19,481,230		
1929	10,368,890		
1930	10,355,970	**14,377,540**	**10 Year Avg**
1931	7,909,706		
1932	14,126,336		
1933	17,794,062		
1934	16,655,140		
1935	12,043,437		
1936	11,563,446		
1937	8,904,145		
1938	12,46,3344		
1939	11,393878		
1940	8,190,419	**12,106,391**	**10 Year Avg**
1941	7,303,190		
1942	12,092,690		
1943	17,627,312		
1944	7,449,142		
1945	10,510472		

1946	14,203,578			
1947	17,718,957			
1948	17,945,962			
1949	13,517236			
1950	18,736,398	**13,730,494**	**10 Year Avg**	
1951	18,837,284			
1952	13,414,817			
1953	12,671,042			
1954	16,535,049			
1955	14,202,263		**13.901.164**	**45 Year Avg**
1956	18,915,457			
1957	13,920,319			
1958	12,658,704			
1959	20,484,328			
1960	14,487,684	**13,564,270**	**10 Year Avg**	
1961	14,472,818			
1962	14,626,494			
1963	12,543,472			
1964	16,773,154			
1965	19,222,868			
1966	13,285,125			
1967	15,870,411			
1968	14,013,430			
1969	16,623,405			
1970	14,289,981	**15,172,116**	**10 Year Avg**	
1971	18,227,999			
1972	19,366,220			
1973	9,348,542			
1974	20,161,548			
1975	17,004636			
1976	17,737,036			
1977	8,358,136			
1978	15,187,038			
1979	13,218,500			
1980	13,424,493	**15,203,415**	**10 Year Avg**	
1981	15,829,504			

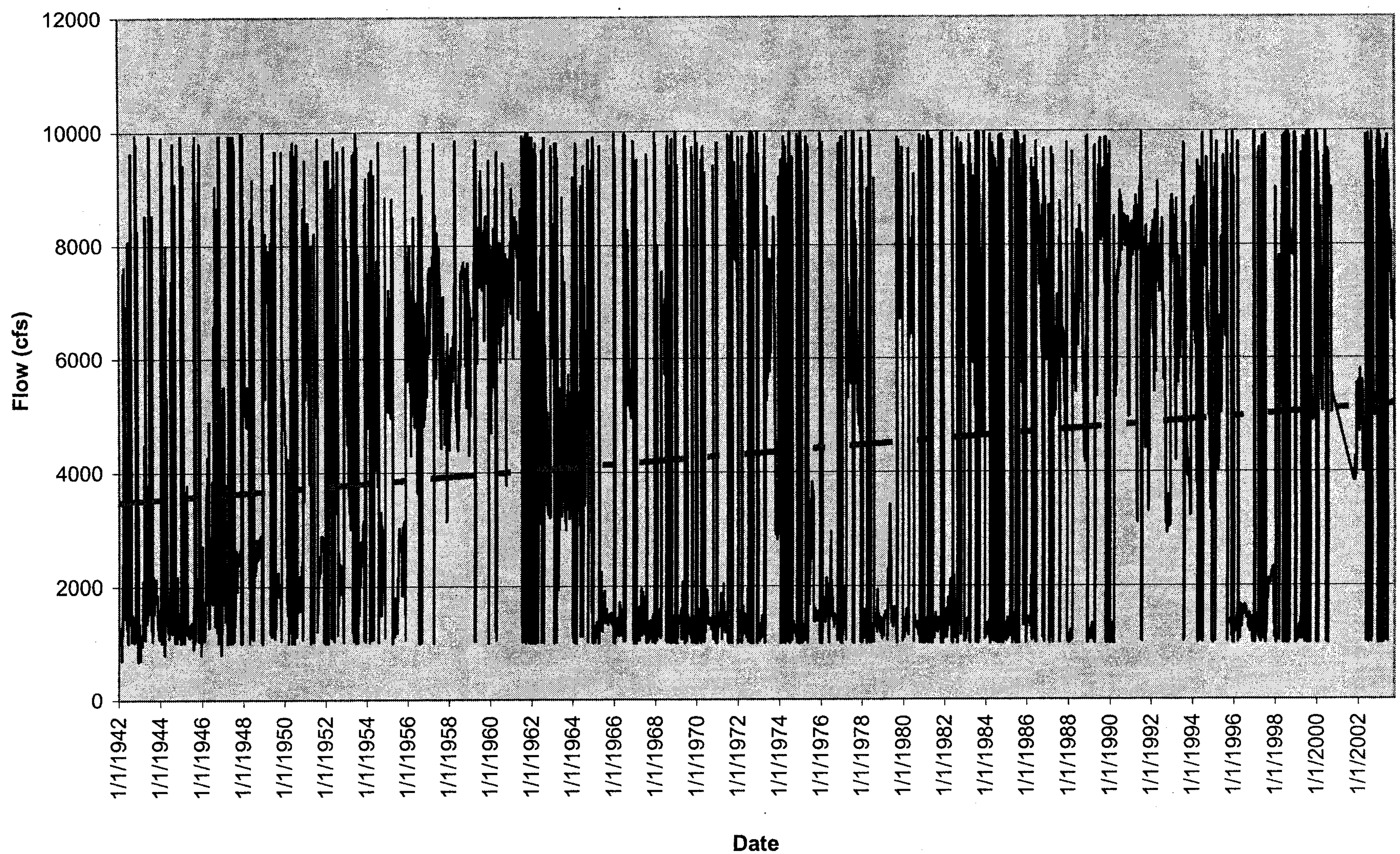
1982	16,090,019			
1983	13,286,984			
1984	12,781,949			
1985	12,988859			
1986	13,694,753			
1987	9,665,463			
1988	9,232,653			
1989	13,195,207			
1990	15,418,159	**13,218,355**	**10 Year Avg**	
1991	16,430,119			
1992	9,331,744			
1993	12,212,204			
1994	9,254,797			
1995	12,996,423			
1996	20,186,811			
1997	21,173,467			
1998	12,335,687			
1999	13,963,423			
2000	11.259.636	**15.456.247**	**14.567.770**	**45 Year Avg**
			14.234.467	**90 year avg**

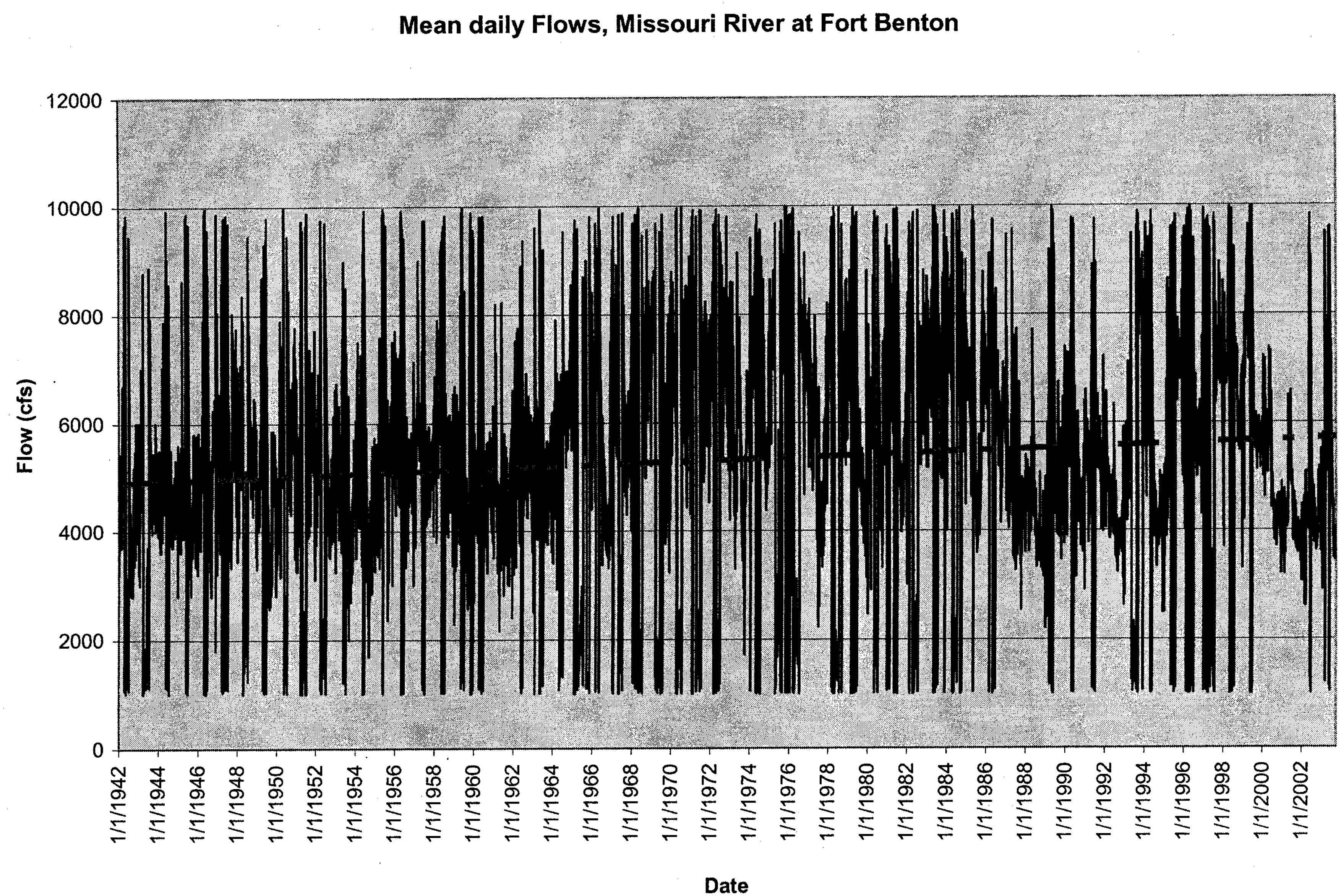
Mean Daily Flows, Clark Fork at Plains



Over an 86 year period, the average daily flow of the Clark Fork River at Plains is a straight line, 20,000 cfs (cubic feet per second). This data from the United States Geological Survey water measuring station indicates that the amount of water used by increased irrigation and increased consumption by other water users has not had a measurable impact on the amount of flow which is available to Avista (built in 1950) to generate electricity. However, the average flow by month has changed dramatically because of the operation of Hungry Horse Dam (built in 1955). In general, Hungry Horse Dam has redistributed the water from high flow months (May, June and July) to the other lower flow months. This operation enables Avista to use 703,277 ac/ft that would have been spilled because the flow rate was in excess of 50,000 cfs turbine capacity. This amount is about 6.5% of the yearly average flow of the Clark Fork River. The 86-year chart on the previous page did not contain 92 years of data because it exceeding the capacity of Excel.

Mean daily Flows, Missouri River near Wolf Point





Mean daily Flows, Missouri River at Fort Benton
Flow (cfs)
12000
10000
8000
6000
4000
2000
0
1/1/1942
1/1/1944
1/1/1946
1/1/1948
1/1/1950
1/1/1952
1/1/1954
1/1/1956
1/1/1958
1/1/1960
1/1/1962
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1/1/1998
1/1/2000
1/1/2002
Date